



# FWS National Wildlife Refuge System Wilderness Fellows Report on Wilderness Character Monitoring

*Fort Niobrara Wilderness  
Prepared by Mark Swenson  
November, 2012*



---

## Table of Contents

Purpose.....	3
Setting .....	3
Geographical Setting .....	3
Ecological Setting .....	4
Wilderness History.....	5
Refuge Purposes and Wilderness Establishment .....	5
Wilderness Character Monitoring .....	7
Measure Selection .....	7
Documents Consulted .....	8
Refuge and NPS Staff Consulted.....	8
Indicators and Measures.....	9
Quality: Untrammeled .....	9
Quality: Natural.....	11
Quality: Undeveloped.....	21
Quality: Solitude or Primitive and Unconfined Recreation .....	25
Other Features – Cultural/Historical Resources.....	31
Dropped Measures .....	32
Conclusion.....	33
Appendix A: Niobrara River Flow Volume.....	35
Appendix B: Measure Prioritization Worksheet .....	38
Untrammeled .....	38
Natural.....	39

---

Undeveloped.....	40
Solitude or primitive and unconfined recreation .....	40
Appendix C: Stream Flow Volume Data.....	45
Appendix D: Fort Falls Visitation Data .....	46

---

# FWS National Wildlife Refuge System Wilderness Fellows Report on Wilderness Character Monitoring

## *Fort Niobrara Wilderness*

### Purpose

---

The purpose of this report is to provide a suite of measures that accurately assess the condition of the Fort Niobrara National Wildlife Refuge (NWR) designated wilderness by establishing baseline data and defining the process for ongoing monitoring of wilderness character trends. This report should help meet the Wilderness Act mandate of “preserving wilderness character” and improve wilderness stewardship by providing managers with a tool to assess changes in the quality of wilderness over time. Additionally, this report should also help explain the results of Fort Niobrara’s wilderness character assessment, and values that have been entered into the National Wilderness Character Monitoring database.



**The Niobrara River Valley. Photo: Mark Swenson**

Additional information on wilderness character monitoring can be found in [Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System](#).

### Setting

---

#### Geographical Setting

Fort Niobrara NWR is located alongside the Niobrara River in Cherry County, Nebraska, four miles northwest of the City of Valentine, and 5 miles south of the South Dakota border. The region is very sparsely populated. According to the 2010 U.S. Census, Cherry County has a population of 5,713 and a population density of 0.95 people per square mile. The rural character of the region is reflected in the rolling prairies, visible for miles in all directions.

---

The refuge is a total of 19,131 acres, and is located near the geographical center of North America. This is reflected appropriately by the diverse collection of ecosystems within refuge borders. The unique convergence of ecosystems is a product of the geographical setting, and plays a central role in shaping the ecological makeup of the refuge.

## Ecological Setting

The Fort Niobrara wilderness area is a 4,635 acre oasis, encompassing a unique convergence of ecosystems unlike any other in the world. Intertwined within the Niobrara River valley of north-central Nebraska, are features of major northern, southern, eastern and western North American plant communities. Eastern and western grasslands merge with the easternmost edge of the Rocky Mountain coniferous forest along the northern river valley walls. Vast sandhills prairie stretches to the southern horizon, eastern deciduous forest spreads throughout the floodplains, and northern boreal forests cluster around cool springs in sheltered branches of the south river valley. The confluence of these varied ecosystems has resulted in abundant wildlife, which includes over 230 native bird species, 40 mammalian species, 24 species of reptiles and amphibians, and several species of fish within the Niobrara River and its tributaries.

The Niobrara River divides the wilderness, with 3,810 acres in a single unit to the north, and approximately 825 acres distributed to the south in portions of four habitat units and approximately five miles of Niobrara River corridor. Public use of the main portion of the wilderness to the north of the river is primarily by hikers or horseback, largely for wildlife observation. Day use is permitted, with public access by foot, horseback, or cross-country ski. The primary public users of the Niobrara River corridor portion of the wilderness are River floaters, who access the area for day-use by canoe or inflatable inner tubes on the river, or by hikers on the Fort Falls Nature Trail. Virtually all of the Niobrara River used by the public on the Refuge is inside the wilderness area, as the wilderness boundary is only a few hundred yards downstream from the launch point (Fort Niobrara CCP, 1999).



**A visitor overlooking the wilderness. Photo: Stewart Schneider**

To traverse the wilderness by foot, or to float through on the Niobrara River, visitors can observe how the varied terrain, climate, flora, and fauna combine to create a network of mixed ecosystems teeming with diversity. Several ecological functions play a prominent role in shaping the ecosystems of the wilderness, including persistent strong winds which continuously shape the landscape, and the Ogallala aquifer which produces numerous waterfalls within the river valley. Historically, regular fires provided disturbance which played a role in the expression of these ecosystems. Grazing was and is another historic disturbance which influenced native plant composition and abundance, and is managed within the wilderness today. Lastly, soil types and the topography of the landscape influence the variety and distribution of plant communities. The collective mosaic of trees, shrubs, and grasslands provide a range



---

of habitat for upland bird species. The abundance of birds contributes greatly to the character of the wilderness, forming a perpetual soundscape and providing continual opportunities for birding.

Several plant and animal species of the wilderness are listed under provisions of the Endangered Species Act. Species listed as endangered or threatened include the, Whooping Crane, Piping Plovers, Blowout Penstemon, Western Prairie Fringed Orchid, American Burying Beetle, and the interior population of the Least Tern (Fort Niobrara CCP, 1999).

## Wilderness History

Archaeological remains collected in this area suggest short-term occupation by prehistoric and historic aboriginal groups for hunting and gathering. Artifacts date back to the Paleo-Indian period of 7,500-11,500 years ago and include scattered flint chips, projectile points, other stone tools, animal bone fragments, charcoal pieces, and pottery pieces. Aboriginal occupation of this region documented in various expeditions of the middle and late 1800's, was by the Dakota Sioux, Ponca, and Pawnee. Other cultural resources predate human occupation, with seventeen fossil sites located within the wilderness, two of which have provided the non-articulated skeletons and bone fragments of more than 20 extinct mammalian species including three-toed horses, camels, antelope, rhinoceroses, rodents, and rabbits.

## Refuge Purposes and Wilderness Establishment

The Fort Niobrara military post was established in 1880, and remained active until 1906. The Fort Niobrara National Wildlife Refuge (NWR) was established at the site of the military post by Executive Order in January, 1912 as a “preserve and breeding ground for native birds.” Its purpose was expanded later that same year to include the “preservation of bison and elk herds representative of those that once roamed the Great Plains” (Fort Niobrara CCP, 1999).

The Wilderness Act was established by Congress in 1964, and created the National Wilderness Preservation System, along with a process for federal agencies to recommend wilderness areas to Congress. The Wilderness Act was set forth to preserve the wild and undeveloped character of the land, by designating areas “where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain...an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions”. In wilderness, people are able to experience the solitude of nature, without many of the intrusions of the modern world.

Under the Wilderness Act, a 4,635-acre portion of Fort Niobrara National Wildlife Refuge was designated as Nebraska's first wilderness area in 1976. The wilderness was established and is managed for the purpose of “preserving the wilderness character of the area, and to contribute to the public purpose of recreational, scenic, scientific, educational, conservation, and historical use.”

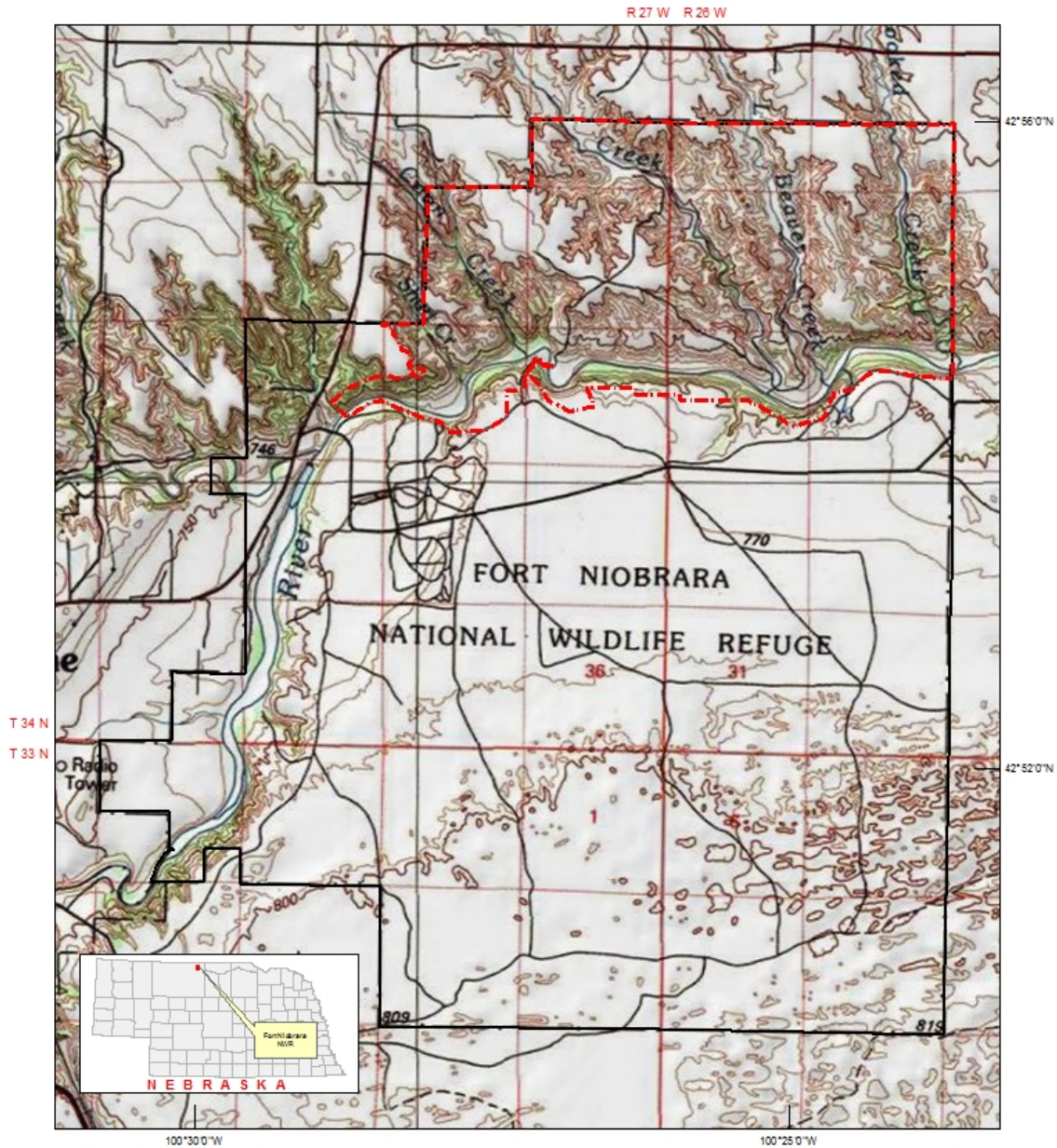
The wilderness straddles the river, with 3,810 acres to the north and 825 acres distributed to the south. The wilderness to the north serves as a winter pasture for the Fort Niobrara buffalo herd; The Niobrara River corridor is fenced separately and has not been grazed in several years. Due to bison grazing and the status of adjoining private land, it is necessary to maintain the boundary fence, control wild fires, monitor and move the bison herd (Fort Niobrara CCP, 1999). Figure 3 below shows the location of the refuge. The wilderness is outlined in red.



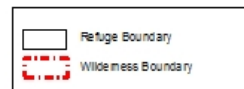
U.S. Fish & Wildlife Service

**Fort Niobrara National Wildlife Refuge**  
Cherry County, Nebraska

*Land Status*



PRODUCED IN THE DIVISION OF REFUGE PLANNING  
DENVER, COLORADO  
LAND STATUS CURRENT TO: 4/14/09  
MAP DATE: 07/18/12  
BASEMAP: DRG  
SIXTH PRINCIPAL MERIDIAN  
FILE: WINEFINMAPSFINLAND.MXD



## Fort Niobrara NWR designated wilderness

---

## Wilderness Character Monitoring

---

Wilderness character is described in “*Keeping it Wild*” as:

“...the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands. These ideals combine to form a complex and subtle set of relationships among the land, its management, its users, and the meanings people associate with wilderness. In total, these relationships and meanings are described as “wilderness character.”

Wilderness character is unique for each wilderness, but consists of qualities that are consistent for all wildernesses. “*Keeping it Wild*” describes these four qualities of wilderness:

**Untrammeled**— The untrammeled quality describes “an area where the earth and its community of life are untrammeled by man,” and “generally appears to have been affected primarily by the forces of nature.” In short, wilderness is essentially unhindered and free from modern human control or manipulation. This quality is degraded by modern human activities or actions that control or manipulate the components or processes of ecological systems inside the wilderness.”

**Natural**— The Wilderness Act states that wilderness is “protected and managed so as to preserve its natural conditions.” In short, wilderness ecological systems are substantially free from the effects of modern civilization. This quality is degraded by intended or unintended effects of modern people on the ecological systems inside the wilderness since the area was designated.

**Undeveloped**— The Wilderness Act states that wilderness is “an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation,” “where man himself is a visitor who does not remain” and “with the imprint of man’s work substantially unnoticeable.” This quality is degraded by the presence of structures, installations, habitations, and by the use of motor vehicles, motorized equipment, or mechanical transport that increases people’s ability to occupy or modify the environment.

**Solitude or a primitive and unconfined type of recreation**— The Wilderness Act states that wilderness has “outstanding opportunities for solitude or a primitive and unconfined type of recreation.” This quality is about the opportunity for people to experience wilderness; it is not directly about visitor experiences per se. This quality is degraded by settings that reduce these opportunities, such as visitor encounters, signs of modern civilization, recreation facilities, and management restrictions on visitor behavior.

These four qualities apply to every wilderness. However, wilderness can also consist of one other quality – **cultural or historical resources**. An example of this quality is the presence of fossil beds in the Fort Niobrara wilderness.

These qualities are further broken down into individual indicators. There are a total of 13 indicators for all five qualities. Each indicator has at least one measure with which to assess that indicator. In this way, the Wilderness Character of a wilderness can be assessed comprehensively.

### Measure Selection

I spent my first week at Fort Niobrara NWR walking all parts of the wilderness, becoming familiar with the area. After that week, I met with Fort Niobrara Project Leader Steve Hicks and Deputy Project Leader



---

Alan Whited to discuss the indicators of wilderness character. Measures were proposed, assessed, and fully developed in coordination with refuge staff in a concerted effort to accurately reflect the current condition of all relevant aspects of the wilderness. Next, baseline data for each measure was collected. I documented sources, indicated all steps in the data collection process, and documented existing values for each measure in this report. During this process, measures were further developed, revised, narrowed, and finalized under the guidance of Wilderness Fellows Program supervisors, and in coordination with Fort Niobrara staff. Any measures with values that could not be established were further evaluated and revised in an effort to record values for as many measures as possible. Values that still could not be established received detailed instructions for future data collection. Values were then added to the Wilderness Character Monitoring Database. Measures were then prioritized by refuge staff based on the following relevancy determinants: Importance, Vulnerability, Reliability, and Reasonableness. The finalized measures are considered suitable for assessing wilderness character, and feasible given refuge time and resources.

## Documents Consulted

- Fort Niobrara National Wildlife Refuge Comprehensive Conservation Plan
- Fort Niobrara National Wildlife Refuge – Wilderness Management Plan
- Fort Niobrara National Wildlife Refuge – Elk and Deer Management Plan and Environmental Assessment
- US Fish and Wildlife Service Fire Management Information System
- Fort Niobrara National Wildlife Refuge – River Recreation Management Plan
- *Paper Birch Decline in the Niobrara Valley: Interactions with Weather and Microclimate*. USGS open File Report.
- *Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System*. USFS, 2008
- Water Quality & Streamflow Monitoring Program Plan—Niobrara National Scenic River. NPS, 2007

## Refuge and NPS Staff Consulted

Steve Hicks – Project Leader  
Alan Whited – Deputy Project Leader  
Kathy McPeak – Biologist  
Troy Davis – Fire Management Officer  
Brett Bowser – Law Enforcement  
Pam Sprenkle – National Park Service Resource Manager

---

## Indicators and Measures

---

### Quality: Untrammeled

#### Measure 1-1: Acres of prescribed burns

**Indicator:** Actions authorized by the Federal land manager that manipulates the biophysical environment

**2011 value:** 0 acres

**Context:** Historically, regular fire regimes have performed an important ecological function in prairie and woodland habitats. Through frequent and regular disturbance, fire was a factor in the expression of Fort Niobrara's wilderness ecosystems. However, current conditions require fire suppression. Changes in habitat due to continuous fire suppression can occur. These changes may also impact the natural condition of a wilderness. Changes may include increased litter layer, changes in plant species abundance and composition, and increased woody vegetation. Prescribed burns are a management tool often used to address these issues and promote native ecosystems. However, within designated Wilderness the use of prescribed burns represents a trade-off, detracting from the untrammeled quality while potentially improving the natural quality.

Prescribed fire has been used very rarely within the wilderness in the past, but may be utilized in the future when it is determined to be in the best interest of the refuge and wilderness. This measure will help monitor the trade-off occurring between the natural and untrammeled qualities of the wilderness, and help to maintain the appropriate balance.

**Relevance:** Wilderness is land where ecological functions have been allowed to operate without human manipulation, and where natural conditions prevail. Human influence of these natural processes - regardless of context - must be carefully considered in regard to its effect on wilderness character, and warrants monitoring. The use of prescribed burns must be carefully weighed, and monitored to determine the appropriate balance between managing to fulfill refuge goals and objectives, while fulfilling the management obligations of designated wilderness.

**Data sources:** Personal communications with Fire Management Officer Troy Davis, and Steve Hicks, Fort Niobrara Project Leader. Fire Management Information System (FMIS).

**Data collection process:** Received FMIS data from Troy Davis listing all of the prescribed fires on the refuge since 1980. FMIS data included the fire name, number, year of occurrence, start date, latitude, longitude, and total prescribed acres. Latitude and longitude information was inserted into the Fort Niobrara NWR GIS database, and fires occurring within the wilderness area were included. Prescribed fire data has been gathered electronically since 1993, but has been very rarely used in wilderness. Only prescribed fire from the 2011 calendar year is utilized as the baseline value (0 acres). Prescribed fire within the wilderness will be documented within the FMIS database, and acres burned can be derived and totaled from this source and confirmed with the Fort Niobrara Fire Management Officer every 3 – 5 years.

**Significant changes:** Any change to acres of prescribed burns is considered significant.

---

**Data adequacy:** Data is complete. All fire information has been entered into the FMIS database since 1993. Data quality is high as there have been very few prescribed fires within the wilderness.

**Measure 1-2: Number of other authorized actions by agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water or fire.**

**Indicator:** Actions authorized by the Federal land manager that manipulates the biophysical environment.

**2011 value:** 8

**Context:** Authorized actions that manipulate plants, animals, pathogens, soil, water, or fire can be necessary duties for successfully carrying out refuge objectives and accomplishing established goals. Actions currently include bison moves, treatments of invasive plants, and hunting occurrences. The untrammeled quality of wilderness is generally degraded by an increase in the number of actions authorized, and enhanced through a decrease in this number.

**Relevance:** Wilderness is land where ecological functions have been allowed to operate without human manipulation, and where natural conditions prevail. Human influence of these natural processes - regardless of context - requires consideration in regard to its effect on the untrammeled quality of wilderness character. This measure will quantify the baseline number of authorized actions and help identify trends over time.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader

**Data collection process:** Value established through personal communications with Alan Whited, Fort Niobrara Deputy Project Leader.

**Significant changes:** An annual change of at least 10%

**Data adequacy:** Due to the low number of authorized actions within the wilderness area, this data is complete in quantity, and of high quality.

**Measure 1-3: Number of other unauthorized actions by agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water or fire.**

**Indicator:** Actions not authorized by the Federal land manager that manipulates the biophysical environment.

**2011 value:** 0

**Context:** Unauthorized actions that manipulate plants, animals, pathogens, soil, water, or fire can negatively impact wilderness character in a variety of ways. This measure will monitor the presence of such actions as an impact to the untrammeled quality of the wilderness. Such actions may include unauthorized hunting, plant or animal removals, user create installations, or others. An increase in the

10 •

---

---

number of unauthorized actions would be considered degrading to the untrammeled quality of the wilderness area.

**Relevance:** Wilderness is land where ecological functions have been allowed to operate without human manipulation, and where natural conditions prevail. Human influence of these natural processes - regardless of context - requires consideration in regard to its effect on the untrammeled quality of wilderness character. Unauthorized actions, especially prohibited actions, can negatively impact wilderness character. This measure will quantify the baseline number of those unauthorized actions and help identify trends over time.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader

**Data collection process:** Meeting with Alan Whited who monitors actions occurring within the wilderness, authorized or unauthorized.

**Significant changes:** The 2011 value is representative of the expected number of unauthorized actions by agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water, or fire. As the expected number is 0, any increase will be considered significant.

**Data adequacy:** Due to the lack of any unauthorized actions within the wilderness area, this data is of complete quantity, and high quality.

## Quality: Natural

### Measure 2-1: Inventory of herbaceous dominated invasive plant communities

**Indicator:** Plant and animal species and communities

**2011 value:** N/A (acres)

**Context:** The Fort Niobrara Wilderness has several herbaceous invasive species appearing throughout the landscape to varying degrees. Current invasive species include Canada Thistle, Purple Loosestrife, Reed Canary Grass, and Leafy Spurge. There is a partial invasive species inventory stored in the Fort Niobrara GIS database, as well as institutional knowledge of each species' preferred habitat and probable quantity. This measure will use the institutional knowledge to efficiently carry out new inventory efforts that will further quantify the extent of herbaceous dominated plant communities, and to fill out the existing GIS database. This will in turn help inform and evaluate future restoration actions. Actions to manage invasive species can be a form of trammeling, but this measure will help strike the necessary balance between maintaining both the natural, and untrammeled qualities of the Wilderness as they relate to invasive plant species.

**Relevance:** This is a relevant measure of the natural quality of the wilderness because the prevalence or absence of invasive plant species in a Wilderness is indicative of the natural quality of plant communities. In the absence of monitoring, this quality runs the risk of unnoticed degradation through increasing numbers of invasive plants. An inventory of these species would provide a quantitative baseline assessment of the natural condition of the Wilderness habitat as it relates to herbaceous dominated



---

invasive plant communities. Additionally, the baseline can provide a measure against which the effectiveness of future management actions can be evaluated.

**Data sources:** Fort Niobrara National Wildlife Refuge Comprehensive Conservation Plan. Fort Niobrara GIS database. Kathy McPeak, Fort Niobrara Biologist. Alan Whited, Fort Niobrara Deputy Project Leader.

**Data collection process:** Existing invasive plant species data is available on the Fort Niobrara GIS database and includes the locations of Canada Thistle. Beginning in the summer of 2013 further inventory efforts will be conducted, and added to the database. Areas of the Wilderness will be selected by Fort Niobrara staff for groups or individuals to walk with GPS units and flagging tape, marking areas dominated by herbaceous invasive plant communities. Locations included in the inventory will be those areas at least 8 ft x 8 ft that are invaded by herbaceous invasive species. The value of the measure is the sum (in acres) of these areas. These areas will be targeted for future spray treatments. Areas which had been dominated by herbaceous invasive species but which have been treated and restored will be removed from the inventory. Evaluations will be conducted every 5 years to determine if herbaceous dominated invasive communities within the Wilderness are increasing or decreasing. Increasing acreage indicates degradation to the natural quality, while decreases indicate an improvement.

**Significant changes:** Because data is currently incomplete to create the inventory, significant changes will be determined based on inventory efforts and data beginning in 2013.

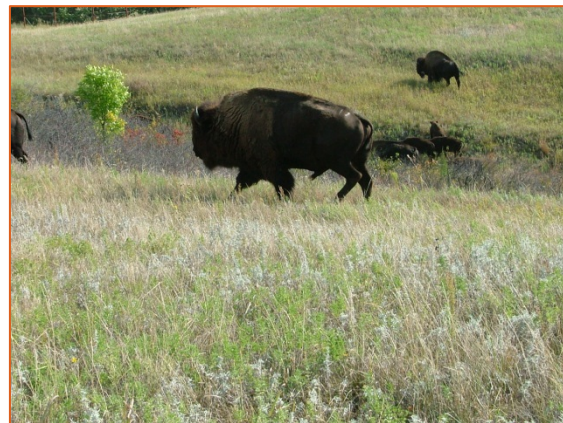
**Data adequacy:** Data is expected to be complete in quantity, and of high quality.

## **Measure 2-2: Species of special management significance**

**Indicator:** Plant and animal species and communities

**2011 value:** 12.5

**Context:** Species of special management significance are those species for which the refuge was established, are protected as endangered or threatened, or are vitally important to preserving habitat. These species include the American Burying Beetle, Beaver, Birds, Bison, Deer, Elk, and Paper Birch. The respective population of each is used as a measure of that species health, as well as a measure of the overall quality of plant and animal communities within the wilderness. These species are especially significant to wilderness character because they may have great influence on their environment, impact management actions undertaken within wilderness boundaries, or are indicators of unique and fragile habitat. This measure will provide comprehensive baseline data regarding the status of those species which are of greatest importance to the wilderness.



**Fort Niobrara NWR maintains a herd of 350 bison.**

**Table 1: Species of Special Management Significance Vulnerability and Significance Scores**

Species	Measure of population health	Value	Vulnerability score*	Significance score**	Weighted status
Birds (multiple species)	Species diversity	230	0	1	0
Bison	# of animals	300 - 350	0	1	0
Burying Beetle	# of beetles	TBD	2	3	5
Deer	# of animals	40-60	.5	1	1.5
Elk	# of animals	5 - 7	2	1	3
Paper birch	# - 11 sample sites	245	2	1	3
<b>Total:</b>					<b>12.5</b>

\*Vulnerability is rated on a scale from 0-3, where 0 = healthy, robust population and 3 = extirpated or no data available

\*\*Significance score

3 = Federally endangered or local high-significance species

2 = Federally threatened or local medium-significance species

1 = Other significant species

**Relevance:** This is a relevant measure of the natural quality of the wilderness because the species themselves are native species which contribute greatly to the natural quality of the wilderness. Dwindling populations result in higher scores for this measure, which indicates a decline in the natural quality. Species population is also indicative of quality natural habitat. Healthy populations are dependent on quality habitat, a reflection of the natural quality of plant species within the wilderness.

**Data sources:** Fort Niobrara Comprehensive Conservation Plan. Alan Whithed, Fort Niobrara Deputy Project Leader, Kathy McPeak, Fort Niobrara Biologist. Fort Niobrara GIS database. "Paper Birch Decline in the Niobrara Valley: Interactions with Weather and Microclimate." USGS open File Report.

**Data collection process:** Species of special management significance were established during discussions with Deputy Project Leader Alan Whithed, and Fort Niobrara Biologist Kathy McPeak. Population values were then established based on various refuge resources and the professional judgment of refuge staff. Significance scores were based upon the status of each species as federally endangered, threatened, or otherwise significant. All species were considered at the very least "otherwise significant", and were assigned a value of 1 with the exception of the American Burying Beetle, which is an endangered species. Population data for the Burying Beetle is expected to be collected by 2013. Lastly, significance scores were assigned through personal communications with Kathy McPeak, based on how healthy the species population was at that time (2012). Data should be recollected annually.

The category of "Birds" is broader than an individual species. This category refers to all birds native to the refuge. The amount and diversity of land-based bird species within the wilderness makes monitoring for each individual species impractical. For that reason, the abundance of bird species was estimated based on current available data, and the professional judgment of refuge staff. Bird species diversity data will become more abundant in the future due to a partnership with the National Park Service, who as of

---

October 2012, are establishing a land-based bird monitoring protocol. This protocol will be used within the river corridor, and there are also plans to conduct the monitoring program within the refuge, including the wilderness. As data from this project becomes available, it will be incorporated into future assessments.

**Significant changes:** Given the small number of species, as well as their significance to the refuge, any changes are considered significant.

**Data adequacy:** Population data is constantly changing, making gathering completely up-to-date data time prohibitive. Data is consequently partial in quantity, and moderate in quality.

### **Measure 2-3: Niobrara flow volume**

**Indicator:** Physical resources

**2011 value:** 0 points

**Context:** The Niobrara River provides the “lifeblood” of the wilderness, influencing the type plant and



**Example of low flow volume during late summer months**

animal communities, and shaping the landscape. Alterations to the flow volume of such an integral part of the wilderness could be influenced primarily by two factors; changes in climate and irrigation’s effect on the surface water flow, and the water table. This measure will monitor the flow volume to measure

---

changes over time, and to quantify the extent of these and other potential impacts on wilderness character.

**Relevance:** This is a relevant measure of the indicator because the Niobrara River is an important element of the natural quality of the wilderness. The Niobrara and its tributaries provide essential habitat for many plant and animal species, and produce the microclimates that support unique species (e.g. Paper Birch). As it is an essential component of adjacent ecosystems, impacts to the flow volume could have a very significant effect on dependent plant and animal communities.

**Data sources:** USGS National Water Information System - USGS water monitoring point 06461500. Annual flow volume statistics. Monthly flow volume statistics.

**Data collection process:** Flow volume data was collected from the USGS website, surface water sampling point 06461500. Annual flow volume and monthly flow volume statistics were gathered from as far back as possible - the first full year of available data was from 1946 - through 2011. This data was used to derive historical annual average, annual peak and low flow averages, standard deviations for each set of average and to determine the natural range for each. Full data summaries are available in Appendix A. Future flow volume values for this measure should be calculated every 5 years by downloading Niobrara River flow volume data from the USGS website. For each full year of available data, the investigator should record three values; the average flow volume, the peak monthly average flow volume, and the low monthly average flow volume. Using this process, there would be 15 values, and 15 possible points for a 5 year period. One point is assigned for each value that falls outside of the range of its associated historical range, displayed below.

**Significant changes:** Assign one point for each value that is outside of its respective 2 standard deviation range shown below. 2 standard deviations were used to capture the wide-range of natural flow volumes of the Niobrara River based upon flow volume data from 1946 – present.

Average annual flow volume: 618 – 922 cubic feet/second

Peak flow volume: 758 – 1390 cubic feet/second

Low flow volume: 352 – 740 cubic feet/second

**Data adequacy:** Data is complete in quantity, and of high quality.

## **Measure 2-4: Extent and magnitude of change in Niobrara River water quality**

**Indicator:** Physical resources

**2011 value:** 13.98%

**Context:** This measure will track water quality of the Niobrara River within refuge boundaries. The Niobrara River provides the basis for much of the flora and fauna currently inhabiting the wilderness, and would be negatively impacted by significant changes to water quality. Water quality varies naturally, but can also experience changes due to unnatural influences, including climate change, surrounding land uses



---

(i.e. nonpoint source pollution), annual precipitation volume and/or intensity, or flushing of adjacent ponds. This measure is intended to identify, separate, and quantify those unnatural impacts to water quality.

**Relevance:** This is a relevant measure of the indicator because the Niobrara River is a resource that supports numerous plant and animal communities of the wilderness. Degradation to the river caused by unnatural changes to water quality would result in degradation to other natural qualities of the wilderness. Because the Niobrara River is part of a much larger watershed, it may experience changes to water quality due to causes that are outside of the Refuge's influence. However, as the wilderness may be impacted by changes to water quality, it is an essential monitoring point in measuring the natural quality of the wilderness.

**Data sources:** NPS Niobrara River water quality data. NPS Contact: Pam Sprenkle, NPS Resource Management Specialist.

**Data collection process:** Management of the river is a collaborative effort with the National Park Service (NPS), who have Scenic River management responsibilities above and below the Fort Niobrara refuge wilderness. NPS monitors water quality of the Niobrara River at multiple locations - including collection points within refuge boundaries. Water quality data from 2001 through 2011 was obtained from NPS Resource Management Specialist Pam Sprenkle. Future water quality monitoring data can be obtained through contact with the Valentine NPS National Scenic River office. All data used in this measure are taken from samples collected at Cornell Bridge. The water quality parameters used here are based upon those set within the NPS water quality standards and protocol, with the exception of water temperature. The water temperature parameter was set using the highest average annual water temperature as recorded from the years 2002 – 2010. 2001 data was excluded because there was only one sample from that year.

The first step was to take the water quality sample values and compare them to the associated water quality parameters, recording each occurrence of a value falling outside of its respective parameter -a 'red flag'. The second step was to divide the total number of 'red flag' values by the total number of samples. This results in the percent occurrence of water quality indicators falling outside of established parameters. For example, in 2011 there were a total of 93 water samples assessed, and 13 of those fell outside of the established parameters -- a 13.98% occurrence rate for 2011. The process is summarized in Table 2 below;

**Table 2: 2011 Niobrara River Water Quality Evaluation**

Indicator	Range	Source	# of samples	# outside range
pH	6.5 - 9	DEP standard	10	2
*Water Temp (c)	< 22.77	NPS data	10	8
Dissolved Oxygen	> 4.0 mg/L	National EPA water quality standard	3	0
Specific Conductivity	150 - 500	"Good mixed fishery level" - EPA 2003	1	0
Salinity	< 0.1 ppth	NPS Water Quality Management Plan	10	0
Turbidity	< 50 NTU	NPS Water Quality Management Plan	10	0
Alkalinity	100 – 250 ppm	NPS Water Quality Management Plan	10	3
Phosphates	Attention level : 0.12 mg/L	NPS Water Quality Management Plan	10	0
Ammonia - Nitrogen	< .25 ppm	NPS Water Quality Management Plan	10	0
Nitrates - Nitrogen	< 10 ppm	NPS Water Quality Management Plan	10	0
Fecal Coliform	< 200 colonies/100 ml	NPS Water Quality Management Plan	9	0
Percentage of 2011 samples outside of established parameters			13.98%	
Historic % occurrence of samples outside of established range, 2002 – 2010:			6.19% - 13.98%	

\* High temperature parameter based on highest average annual temperature from 2002 – 2011 data.

**Significant changes:** Using the same process, water quality data from 2002 – 2010 was also assessed and scores were recorded to help establish the range of percent occurrence of water quality indicators falling outside of the established parameters. The lowest percentage (6.19% in 2007) and the highest percentage (13.98% in 2011) represent the natural range, and also define what constitutes a significant change. Annual percent occurrences of 'red flags' exceeding 13.98% are considered a significant degradation of water quality, and percent occurrences lower than 6.19% are considered significant improvements to water quality. Data should be collected and reassessed annually. Water quality data from 2001 - 2011 is available on the Fort Niobrara Group data server.

---

**Data adequacy:** Data is of complete quantity and high quality.

**Measure 2-5: Stream flow volume:**

**Indicator:** Physical resources

**2011 value:** 3.65 cubic feet/second

**Context:** Stream flow volume is an assessment of existing flow volume, and a measure of variation in flow volume for Big Beaver Creek, Crooked Creek, and Fort Falls Creek. These three prominent streams flow into the Niobrara River, through wilderness. The cold, spring fed streams are mainly dependent upon the Ogallala Aquifer as their primary water source, but are also influenced by precipitation volume and intensity. Flow volume can also be influenced by off-refuge impacts, such as declining water table due to climate, and/or increasing levels of irrigation. Declining natural flow volume indicates degradation to the Natural quality of the wilderness.

**Relevance:** Stream flow volume is a relevant measure of the indicator because it plays an integral part in shaping the landscape, contributes a spring-fed water source to the Niobrara River, and supports plant and animal communities which develop in their immediate vicinity. Stream flow volumes are also sensitive indicators of changes to natural conditions. For these reasons, flow volume is an informative measure of the Natural Quality of Wilderness, and should be monitored accordingly.

**Data sources:** Kathy McPeak, Fort Niobrara NWR Biologist



**Ogallala aquifer groundwater creating ice formations at the Fort Falls bend**

**Data collection process:** Stream flow volume is collected at designated points annually. 2011 data for Big Beaver and Crooked Creeks were collected on nine separate occasions from the month of April 2011,

---

to August 2011. Fort Falls flow volume will be collected in the future, but is not included in the 2011 value. For this reason, flow volumes can be expected to increase in future values. Flow volume was calculated by measuring stream depth, and water velocity, measured every 6 inches from one side of the creek to the other. Data from each collection was then entered into a Microsoft Excel spreadsheet, which calculated and summarized the flow volume of each creek. The flow volume average for each creek was calculated by averaging the flow volume for each creek, using the nine samples. The average annual flow volumes for each creek were then added together to get the 2011 value. For complete flow volume data for each creek, refer to Appendix C.

**Significant changes:** Significant changes to stream flow volume will be determined after 5 years of data collection to account for the addition of Fort Falls data, and to establish some range of natural variation.

**Data adequacy:** Because the Fort Falls data has not yet been included, data is currently incomplete in quantity, and of high quality.

## **Measure 2-6: Extent and magnitude of change in stream water quality**

**Indicator:** Physical resources

**2011 value:** N/A

**Context:** The spring fed streams have helped shape the wilderness landscape, and provide important habitat for plant and animal populations. Multiple species of fish and wildlife utilize the streams and adjacent riparian areas for their pristine, native habitat. As part of the National Park Service's management efforts of the Niobrara Scenic River, they collect stream water quality data.

**Relevance:** The extent and magnitude of change in stream water quality is a relevant measure of the indicator because water quality supports surrounding plant and animal communities, and feeds into the Niobrara River. Water quality is also a sensitive indicator of impacts to natural conditions. Surrounding land uses and practices can have an effect on water quality, and this measure will help monitor and quantify the presence and extent of such impacts. . For this reason, stream water quality monitoring is an informative measure of the Natural Quality of the wilderness, and should be monitored accordingly.

**Data sources:** National Park Service water quality data. Stream water quality data collection began on July 9<sup>th</sup>, 2012. Stream water quality data will be gathered several times during the summer months annually by NPS staff and shared with USFW for purposes of wilderness character monitoring.

**Data collection process:** Contacted NPS staff about ongoing water quality monitoring of wilderness streams. Collected existing data from NPS. NPS contact: Pam Sprenkle, National Park Service Resource Manager.

**Significant changes:** Wilderness resources are not static, and some variation in measurable qualities can be expected over time. For this reason, water quality indicators listed within the data collection process should be expected to vary from one year to another. Data collection has just recently begun, and significant changes will be determined after 5 years of monitoring. After 5 years, data will be assessed to



---

make an informed decision on establishing natural variation for each water quality parameter. Significant changes to water quality will be indicated by values falling outside of that range.

**Data adequacy:** Data is of complete quantity and high quality.

## **Measure 2-7: Air Quality – Visibility based on average deciview**

**Indicator:** Physical resources

**Context:** Polluted air injures wildlife and vegetation, acidifies water, degrades habitats, and impairs visibility. Deciview is a cumulative haziness index used to express light extinction. Essentially, deciview is the measure of visibility a wilderness visitor would experience. Fine nitrate and sulfate directly indicate degradation of visibility conditions. The natural quality is degraded if visibility declines.

**Data sources:** Values for this measure will be gathered nationally for all four wilderness managing agencies.



**Historically representative bison grazing occurs within the wilderness**

intensity of grazing could result in changes to the natural quality of the wilderness. This measure will help in monitoring such changes.

**Relevance:** AUM's of bison grazing is a relevant measure of the indicator because it is reflective of the bison herd's impact on the land. Bison grazing is a disturbance which helps limit woody vegetation, reduces the litter layer, and enhances native plant species habitat. Changes to AUM's would reflect

## **Measure 2-8: Animal Unit Months (AUM's) of bison grazing**

**Indicator:** Biophysical processes

**2011 value:** 2,100 AUM's – 350 animal units x 6 months

**Context:** This measure will monitor grazing within the wilderness on an annual basis. The wilderness is presently grazed by a herd of 350 bison during the winter months. This amount of grazing is considered representative of historical grazing intensity, and helps to maintain the natural condition of the wilderness. Significant deviation from this established

---

changes in the current herd, and/or use of the wilderness area. Significantly more or less AUM's are both considered degradation to the natural quality of the wilderness.

**Data sources:** Alan Whited, Deputy Project Manager. Fort Niobrara Comprehensive Conservation Plan

**Data collection process:** Discussed the number of bison and the amount of time spent within the wilderness area with Alan Whited. The total number of bison (350 bison – one animal unit/bison), is multiplied by the number of months spent grazing in the wilderness (6 months). The resulting number is total AUM's.

**Significant changes:** Changes of 10% or more in total AUM's is considered significant.

**Data adequacy:** Due to the significant management the bison herd involves, data is of complete quantity, and high quality.

## Quality: Undeveloped

### Measure 3-1: Miles of fencing

**Indicator:** Non-recreational structures, installations, and developments

**2011 value:** 13 miles

**Context:** A fence exists around the perimeter of the wilderness area, totaling 12.5 miles in length. The fence exists to delineate the boundary between the wilderness and surrounding private lands, and is an installation necessary for management of the bison herd. Any unnecessary fencing within the wilderness area has been removed, and no plans exist to add additional fencing.

**Relevance:** This is a relevant measure of the undeveloped quality of the wilderness area because fencing constitutes a man-made installation and is a clear barrier placed on the landscape.

**Data sources:** Fort Niobrara GIS data.

**Data collection process:** Boundary information was located within the Fort Niobrara GIS database, and a measurement of the existing mileage of the wilderness area was conducted. Increases in the number of miles of fencing signify degradation to the undeveloped quality, while decreasing the miles of fencing improves the undeveloped quality.

**Significant changes:** Any change in the miles of fencing is considered significant.

**Data adequacy:** Data is of complete quantity and high quality.

### Measure 3-2: Miles of non-recreational road and trail

**Indicator:** Non-recreational structures, installations, and developments

---

**2011 value:** 22 miles

**Context:** The non-recreational temporary roads and trails were general access routes spread throughout the wilderness before wilderness designation in 1976. Few of these former access roads and trails are still visible, but traces can still be seen throughout the wilderness. These roads and trails are infrequently maintained, and are growing over, eroding, and otherwise disappearing. Some access maintenance is performed for fire safety.

**Relevance:** Miles of non-recreational temporary road and trail are a relevant measure of the undeveloped quality of the wilderness because they are a form of development. A larger presence of non-recreational temporary road and trail would lower the undeveloped quality of a wilderness.

**Data sources:** Fort Niobrara GIS data.

**Data collection process:** Non-recreational temporary road and trail information was located within the Fort Niobrara GIS database, and a value was derived using GIS measurement tools.

**Significant changes:** Any additional non-recreational roads or trails will be considered significant.

**Data adequacy:** Data is of complete quantity and high quality.

### **Measure 3-3: Number of other non-recreational structures and installations**

**Indicator:** Non-recreational structures, installations, and developments

**2011 value:** Total of 8 structures and installations

**Context:** All current structures, installations, and developments located within the wilderness have been there since before wilderness designation, and are not currently maintained. This includes a cabin, a levee/water control structure on Big Beaver Creek, and 6 bridges. These installations have not been removed because their removal may introduce more impact and intrusion on the wilderness. For this reason, the decision has been to leave these structures as they are. Some consideration for removal may be given to certain structures if a non-intrusive and efficient method is determined, or if it is determined that the structure may pose a threat to resources.

**Relevance:** This measure is relevant to the indicator because it reflects the prevalence of structures, installations, or other developments inside the wilderness. A wilderness generally retains its primeval character and is essentially without permanent improvement and modern human occupation. Structures, installations, and development are contrary to this quality, and indicate degradation to the undeveloped quality of the wilderness.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader.

**Data collection process:** Personal communication with Alan Whited about the number of non-recreational structures and installations within the wilderness area.

**Significant changes:** A 10% change in number of non-recreational structures and installations is considered significant.

---

**Data adequacy:** Data is of partial quantity, and moderate quality.

### **Measure 3-4: Acres of inholdings**

**Indicator:** Inholdings

**2011 value:** 0

**Context:** Inholdings are privately owned parcels located within the wilderness area, generally under private ownership before wilderness designation. The Fort Niobrara Wilderness area does not have any inholdings present.

**Relevance:** Acres of inholdings are a relevant measure of the undeveloped quality of the wilderness area because inholdings are not encumbered by the same constraints as wilderness, and may be developed at the landowner's discretion. Homes may be built, forestland logged, and right-of-way access may be required of these lands, leading to the construction of roads. In the case of the Fort Niobrara wilderness, the introduction of any inholdings would be degrading to the undeveloped quality.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader

**Data collection process:** Confirmed with Alan that there were no inholdings currently existing within Fort Niobrara wilderness areas.

**Significant changes:** Because the wilderness has no inholdings, any increase is considered significant.

**Data adequacy:** Data is considered complete in quantity, and of high quality.

### **Measure 3-5: Number of authorized motor vehicle or mechanical transport entries**

**Indicator:** Use of motor vehicles, motorized equipment, or mechanical transport

**2011 value:** 15

**Context:** Several authorized motor vehicle or mechanical transport entries into the wilderness occur each year. In 2011, 15 such entries occurred: 4 vehicle entries twice per year for bison moves, and an additional 7 entries for purposes of fencing, law enforcement, or miscellaneous actions requiring prompt action. Generally, motor vehicle or mechanical transport is not permitted within wilderness, and this measure will help sustain the lowest possible number of such entries. Current authorized motor vehicle or mechanical transport entries are done to implement management actions in the best interest of the refuge.

**Relevance:** The number of authorized motor vehicle or mechanical transport entries into the wilderness is a relevant measure of the undeveloped character of the wilderness because motorized or mechanical transport when present within a wilderness indicates mechanization encroaching upon the undeveloped



---

and unimproved wilderness. This detracts from the undeveloped quality, and reduces the necessity of wilderness visitors to practice self-sufficiency.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader.

**Data collection process:** Meeting with Alan about the number of authorized motor vehicle or mechanical transport entries.

**Significant changes:** Because some level of variation in this annual value is common, a change of 20% is designated as significant.

**Data adequacy:** Data is of complete quantity, and high quality.

### **Measure 3-6: Number of non-authorized motor vehicle or mechanical transport entries**

**Indicator:** Use of motor vehicles, motorized equipment, or mechanical transport

**2011 value:** 1

**Context:** The number of non-authorized motor vehicle or mechanical transport entries reflects a direct violation of refuge regulations. Due to the potential impacts to the landscape such entries could cause, their presence could quickly degrade the undeveloped quality of the wilderness. This measure will track such entries in an effort to keep the number as low as possible.

**Relevance:** This is a relevant measure of the indicator because the presence of unauthorized motor vehicles or mechanical transport entries represents degradation to the undeveloped quality of the wilderness through the introduction of unauthorized mechanization within the wilderness. Authorized motor vehicle or mechanical transport entries are done for the benefit of the wilderness, whereas unauthorized entries could cause degradation of the undeveloped quality of the wilderness without any redeeming quality.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Manager

**Data collection process:** Meeting with Alan about the number of non-authorized motor vehicle or mechanical transport entries.

**Significant changes:** Because unauthorized entries are prohibited, any change in occurrence is considered significant.

**Data adequacy:** Data is partial in quantity, and moderate in quality due to the impossibility for surveillance of the entire wilderness.

---

## Quality: Solitude or Primitive and Unconfined Recreation

### Measure 4-1: Number of river-based visitors

**Indicator:** Remoteness from sights and sounds of people inside the wilderness

**2011 value:** 8,042

**Context:** The Niobrara River is an important and highly used part of the Fort Niobrara wilderness. The portion of river located within refuge confines is included in the designated wilderness, providing recreation to the public with thousands of people visiting the Cornell Dam launch point each year to canoe, kayak, or tube. This level of use necessitates oversight, which includes monitoring the number of river-based visitors. River Recreation Reports indicate that the number of river-based visitors has been declining since the 1990's, and is currently well under the limit set within the 2005 River Management Plan of 20,300 river-based visitors permitted annually. The amount of river-based visitation impacts the area's remoteness from sights and sounds of people inside the wilderness, and this measure will quantify the extent of this impact.



#### River visitors at the Fort Niobrara Canoe Launch

**Relevance:** This is a relevant measure of the indicator because the number of river-based visitors is by far the main contributor to sights and sounds of people inside the wilderness. The river, along with river-based visitors, is visible from much of the land-based wilderness. For this reason, the number of river-based visitors is indicative of the level of sights and sounds of people inside the wilderness. A significant increase in the number of river-based visitors would indicate a decline in this quality.

---

**Data sources:** 2011 Report of River Recreation on Fort Niobrara NWR

**Data collection process:** Data is collected and compiled annually in a report of River Recreation. Launch data is provided by outfitters (monthly reports) and iron ranger (fee collection) envelopes, which are entered into an Excel spreadsheet, compiled, and summarized. Data has been collected since 1993, and is used within the Wilderness Character Monitoring database to determine trends. Rising numbers of river-based visitors indicates degradation to the quality of solitude or primitive and unconfined recreation. Lower numbers indicates an improvement to this quality.

**Significant changes:** Annual changes of at least 25% are considered significant.

**Data adequacy:** Data is of partial quantity, and moderate quality. The data considered partial and moderate because of the issue of unpermitted launching, which has occurred regularly, and accounts for an unknown number of river users.

## **Measure 4-2: Number of visitors to Fort Falls**

**Indicator:** Remoteness from sights and sounds of people inside the wilderness

**2010 value:** 8,037

**Context:** Fort Falls is located within the wilderness, and the Fort Falls trail is the location of most recreational installations within the wilderness. Installations are listed in measure 4 – 6. Every year, thousands of people visit Fort Falls, and walk the trail, making it the most highly visited land-based portion of the wilderness. Fort Falls is located on the south side of the Niobrara River, isolating it from the majority of the wilderness acreage located north of the River. This measure will provide a quantitative representation of existing visitor use of the Wilderness.

**Relevance:** The number of visitors to Fort Falls is a relevant measure of the quality of solitude and primitive and unconfined recreation for the wilderness because the greater the number of visitors to a wilderness, the less remote from sights and sounds of people inside the wilderness those visitors are. Fort Falls receives a high level of visitation relative to the wilderness on the north side of the river.

**Data sources:** Data is gathered by the National Park Service by car counter, located outside of the gate leading to the Fort Falls parking area. Contact NPS for updates to annual visitation.

**Data collection process:** Data is collected annually by the National Park Service, and should be entered into the wilderness character monitoring database annually. The National Park Service uses a car counter at the Fort Falls entrance to monitor visitor use, and shares this data with Fort Niobrara NWR staff. Car counter data can be solicited from the NPS office in Valentine if not available at Fort Niobrara. Data has been collected since 2002

**Significant changes:** Changes in the number of visitors of 25% or more annually are considered significant. Increases in the number of visitors indicate a decline in the quality of solitude or primitive and unconfined recreation.

**Data adequacy:** Data is of complete quantity and high quality.

---

### **Measure 4-3: Number of visitors on horseback**

**Indicator:** Remoteness from sights and sounds of people inside the wilderness

**2011 value:** 55

**Context:** A significant portion of yearly visitors to the wilderness enter on horseback, making the number of visitors on horseback a viable measure of visitation. Visitors on horseback are permitted within the Fort Niobrara wilderness area. Those on horseback include both refuge staff and the general public. Staff may enter on horseback throughout the year for several reasons, including; locating invasive species, bridge inspection, bison herd moves, or wildlife monitoring. People visiting the wilderness on horseback are neither common, nor uncommon. This fact had an influence on the change in the number of visitors on horseback necessary to be considered 'significant' (50%).

**Relevance:** The number of visitors to the wilderness on horseback is a relevant measure of solitude or primitive and unconfined recreation because there are a significant number of visitors on horseback over the course of a year. Visitors on horseback are easier to track than visitors on foot, and are a good indication of the number of non-river based visitors of the wilderness. Significant increases to the number of visitors in a wilderness can negatively impact the opportunity for solitude or primitive and unconfined recreation those visitors may experience.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader.

**Data collection process:** Personal communication with Alan about the annual number visitors on horseback.

**Significant changes:** A change in the number of visitors on horseback of 50% or more is considered significant.

**Data adequacy:** Data is considered of complete quantity, and of moderate quality. Quality is moderate because there is no formal system in place to monitor non-river based visitors to the wilderness area.

### **Measure 4-4: Acres of wilderness affected by adjacent access routes, travel routes, or development.**

**Indicator:** Remoteness from occupied and modified areas outside the wilderness

**2011 value:** 1,354 acres.

**Context:** Access routes, travel routes, and development surround the Fort Niobrara Wilderness area in all directions. Highway 12 is located to the west and north of the refuge. A network of gravel roads exists within the refuge for maintenance purposes, law enforcement, and visitor use. Several of these are located near the wilderness to the south and east. Multiple access routes lead to and from the wilderness. The Fort Niobrara wilderness is small in size relative to many other designated wilderness areas which increases the percentage of the total acreage affected by adjacent land uses. The prevalence of adjacent

---

access routes, travel routes or development reduces the remoteness of a wilderness from occupied and modified areas.

**Relevance:** Features such as access routes, travel routes, and development adjacent to a wilderness can impact the quality of solitude or primitive and unconfined recreation of a wilderness depending upon the proximity to the wilderness. For this reason, an evaluation of existing conditions is necessary as a measure of the quality of solitude or primitive and unconfined recreation. This quality is degraded whenever there is an increase in adjacent access routes, travel routes, or development in close proximity to the wilderness.

**Data sources:** Fort Niobrara GIS data.

**Data collection process:** Assessed every five years, the proximity of these features to the wilderness is the simplest method for assessing their potential impact to the quality. GIS analysis was used to compute the number of acres of wilderness that are inside a 1/2 mile buffer for paved roads(Highway 12), and inside a 1/4 mile buffer of gravel roads and dwellings outside of the wilderness. The area of wilderness located inside this buffer is the resulting value. This quality is degraded if the affected area increases.

**Significant changes:** Any change to this value indicates an increase or decrease to the number of occupied or modified areas in proximity to the wilderness, and is considered significant.

**Data adequacy:** The data is of complete quantity, and high quality.

## **Measure 4-5: Miles of developed recreational trails**

**Indicator:** Facilities that decrease self-reliant recreation

**2011 value:** 0.9 miles

**Context:** Developed recreational trails play a role in the Fort Niobrara wilderness. The Fort Falls Trail is a 0.9 mile improved trail, beginning and ending in a parking area adjacent to the wilderness. From the parking area, the trail forms a loop within the wilderness. The trail leads visitors past Fort Falls, toward the river alongside Fort Falls Creek, then turns and parallels the south river bank before looping back uphill to the parking area. Relative to the rest of the wilderness, this trail is highly developed and intensively used. In 2010 alone, 8,037 visitors used the Fort Falls trail. This is the only developed trail within the wilderness, but does have an effect on wilderness character by providing facilities that decrease self-reliant recreation.. For this reason, it is necessary to measure its contribution to the indicator.

**Relevance:** Developed recreational trails detract from the primitive quality of wilderness. Therefore, further development of trails should be carefully monitored and considered with respect to the impact trail development has on wilderness character. Additional trail development would signify a decrease in the quality of solitude or primitive and unconfined recreation.

**Data sources:** Fort Niobrara NWR GIS data. Fort Niobrara Comprehensive Conservation Plan. Alan Whited, Fort Niobrara Deputy Project Leader. Site visit to the Fort Falls Trail.



---

**Data collection process:** Data regarding developed recreational trails was initially gathered through review of the Comprehensive Conservation Plan, followed by site visits. No additional developed trail exists within the wilderness, as confirmed through personal communications with Fort Niobrara Deputy Project Leader Alan Whited. This measure should be reassessed every five years, although documentation of trail development can be expected as it occurs.

**Significant changes:** Any change in mileage of developed trail is considered significant.

**Data adequacy:** This data is considered of complete quantity and high quality.

#### **Measure 4-6: Number of other recreational facilities/installations**

**Indicator:** Facilities that decrease self-reliant recreation.

**2011 value:** 36

**Context:** The Fort Falls Nature Trail and related recreational facilities or installations are located on the south side of the Niobrara River, less than 1 mile northeast of the Fort Niobrara Visitor Center. The river separates this portion of the wilderness from the contiguous, undeveloped portion of the wilderness to the north. This is the only developed trail within the Fort Niobrara Wilderness. The following is an inventory of recreational facilities and installations available for visitor use within the wilderness:



**The Fort Falls Trail. Photo: Steve Hicks**

- 22 interpretive signs along nature trail
- 5 sections of wood hand railing
- 5 pedestrian bridges
- 3 benches
- 1 observation point (Note: The Turkey Vulture observation point northwest of the parking area. Parking lot observation deck and signs are outside the wilderness.

The remainder of the Fort Niobrara Wilderness is entirely without recreational facilities or installations.

**Relevance:** This measure is relevant for assessing the quality of solitude or primitive and unconfined recreation because recreational facilities within the wilderness have the effect of decreasing self-reliant recreation. A central quality of wilderness is its ability to provide the opportunity for primitive and unconfined recreation. Accordingly, while there are no recreational facilities provided within the wilderness outside of the Fort Falls nature trail, it is important to include any such facilities in a wilderness character assessment due to their potential impacts on the quality of solitude or primitive and unconfined recreation.

---

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader, site visits.

**Data collection process:** Data regarding developed recreational facilities was initially gathered through the Comprehensive Conservation Plan, followed by a discussion with Fort Niobrara Deputy Project Leader Alan Whited regarding the total number of recreational facilities. This was confirmed through GIS data analysis, and a site visits to the wilderness area where a simple count of each type of facility or installation was conducted.

**Significant changes:** Due to the potential impact of additional recreational facilities, and because the vast majority of wilderness is without recreational facilities, any change to the number of recreational facilities is significant. An increase in the number of recreational facilities or installations would represent degradation to the quality of solitude or primitive and unconfined recreation, a decrease is considered an improvement.

**Data adequacy:** Data is of completed quantity and high quality.

#### **Measure 4-7: Index of restrictions on river-based visitors**

**Indicator:** Management restrictions on visitor behavior

**2011 value:** 9

**Context:** Current restrictions are those that have been determined necessary to allow the general public to utilize the river for compatible wildlife dependent recreation, while preserving the ability of land-based wilderness visitors to experience solitude and primitive and unconfined recreation. Generally in wilderness, more restrictions on visitor behaviors signify a lower quality of solitude or primitive and unconfined recreation. In this case however, loosening restrictions would have the general effects of degrading wilderness character by permitting more invasive or aggressive visitor use. Maintaining the appropriate level of restrictions prevents this from occurring.

**Table 3: Visitor Restrictions**

Category*	# of tickets/warnings	Significance score**	Comments
Access Fees	9	1	\$1 river access permit required
Alcohol	97	4	No alcohol allowed
Boat restrictions	15	2	No motor boats allowed
Group size	18	2	No more than 5 tubes allowed together
Campfires	0	0	No campfires allowed
Camping	0	0	No overnight camping allowed
Radios	2	0	No loud radio
Water guns	0	0	No water guns/balloons
Visitation hours	3	0	Daylight hours only
Total Score:		<b>9</b>	

\*Additional categories can be added as needed

\*\* Significance score is rated on a scale from 0 - 4, where 4 indicates the most significant restrictions

---

**Relevance:** This is a relevant measure because the Niobrara River is an important resource to the refuge, a defining characteristic of the wilderness, and the largest visitor attraction in the refuge. These restrictions were developed to ensure that visitor use and behaviors comply with permitted uses. This measure will help to strike the appropriate balance between visitor restrictions, and the quality of solitude or primitive and unconfined recreation.

**Data sources:** Fort Niobrara National Wildlife Refuge – River Recreation Management Plan. Cornell Dam launch point listed regulations. Brett Bowser, Fort Niobrara NWR Law Enforcement.

**Data collection process:** Gathered a list of regulations from the Fort Niobrara River Management Plan, followed by launch point sight visit, and documentation of regulations listed for visitor observation. To determine the restriction score, the number of tickets and warnings written for 2011 were collected from the Uniform Crime Report of Fort Niobrara Law Enforcement official, Brett Bowser. Significance scores are based upon the number of tickets and warnings of each kind according to the following scoring criteria;

- 0:** 0 – 5 tickets/warnings
- 1:** 6 – 10 tickets/warnings
- 2:** 11 – 20 tickets/warnings
- 3:** 21 – 49 tickets/warnings
- 4:** 50 or more tickets/warnings

Note: Future restriction scores may vary for two reasons: 1) A different law enforcement official may utilize different methods to enforce restrictions. 2) 2011 was the first year for the current Fort Niobrara Law Enforcement Official. Tickets and warnings issued have gone up since 2011 because of increased familiarity with restrictions and enforcement methods as well as increased documentation of warnings issued.

**Significant changes:** A change in total score of more than 3 points is considered significant. This index seeks to monitor the balance reached in enforcement of restrictions on visitor behavior done in the interest of resource protection, while allowing for the highest possible quality of solitude or primitive and unconfined recreation. Increases to this number suggest more prohibited uses occurring within the wilderness, which indicates a decrease in the quality of solitude or primitive and unconfined recreation. A decrease in this number indicates less prohibited actions occurring within the wilderness, which is considered an improvement.

**Data adequacy:** Data is of complete quantity, and moderate quality. Data is of moderate quality because of the use of professional judgment used in determining the significance score criteria.

## Other Features - Cultural/Historical Resources

### Measure 5-1: Number of fossil or archeological artifact removals

**Indicator:** Loss of statutorily protected cultural resources

**2011 value:** 0

---

**Context:** This measure will monitor the preservation of fossils and other archeological resources of the wilderness. Fossils and other archeological artifacts are well-documented within Fort Niobrara's wilderness, signifying the occupation and use of the Niobrara River Valley's resources by prehistoric animals and aboriginal groups. The Wilderness contains seventeen fossil sites, two of which have provided the non-articulated skeletons and bone fragments of more than 20 extinct mammalian species. Archeological remains also indicate occupation by prehistoric and historic aboriginal groups for hunting and gathering.

**Relevance:** Monitoring the number of removals of fossils or archeological artifacts is directly related to the "Loss of statutorily protected cultural resources indicator". Cultural resources such as fossils and archeological artifacts are irreplaceable relics of history, and powerful evidence of the primeval character of the wilderness. For this reason, it is important to monitor any removals of these resources. Any fossil or archeological artifact removals indicate degradation of this quality.

**Data sources:** Alan Whited, Fort Niobrara Deputy Project Leader. Brett Bowser, Fort Niobrara Law Enforcement.

**Data collection process:** Personal communications with Fort Niobrara Deputy Project Leader Alan Whited and Fort Niobrara Law Enforcement official Brett Bowser. Each indicated no removals of fossils or archeological artifacts occurring within the Wilderness Area.

**Significant changes:** Any changes to the removal of fossil and archeological artifacts are considered significant.

**Data adequacy:** Data is considered partial in quantity, and of moderate quality. Data is partial because artifacts could be removed from the wilderness area without the knowledge of Fort Niobrara staff, and because there is no inventory of all existing fossil or archeological artifacts existing within the wilderness. Data is moderate in quality primarily because it is based largely on professional judgment, without the capacity to thoroughly inventory existing resources.

## Dropped Measures

### Measure: Percent of natural fires manipulated

**Reason:** 100% of natural fires that aren't natural outs are suppressed. Therefore, this measure just indicates what we know already, because it is the policy at Fort Niobrara. This policy is also not going to change, because it is done for the purpose of protecting the surrounding properties.

### Measure: Acres treated for invasive species

**Reason:** Fort Niobrara NWR did not have data regarding acreage of invasive species. Also, such data would be irrelevant because regardless of the extent of invasive species, future treatments still depend on the refuge's available resources to treat invasive plants. For that reason, this measure holds no influence with regard to the untrammeled quality, nor does it provide an indication of the extent of invasive species within the wilderness.

---

## Measure: Acres burned by fire

**Reason:** This measure also includes naturally occurring fires in addition to prescribed burns. Ultimately, measure 1-1 is more effective because it only monitors prescribed burns. Including naturally occurring fires does not contribute anything, because those fires will be responded to. This is a redundant measure that doesn't add much to the assessment, and will not influence future decisions regarding fire.

## Conclusion

---

This suite of measures cannot capture all aspects of the Fort Niobrara wilderness, but should provide a useful, feasible, and efficient quantitative indication of trends in each quality. In my opinion, the Fort Niobrara NWR wilderness is a diverse, high quality wilderness with a small number of issues that cannot be totally resolved, largely because they are the result of outside influences. However, these issues are well known and are addressed through the management of the wilderness whenever possible in ways that are in the best interest of the refuge, and in line with the principles of the Wilderness Act.

I believe the greatest threat to the wilderness is the effect that changes in climate could have on sensitive habitat. For Niobrara's Wilderness Character is largely a result of the unique collection of divergent habitats coexisting within this small area. According to visitor center data, there are 160 plant and animal species at Fort Niobrara NWR that are on the edge of their distributional ranges. Given this large number, seemingly small climatological shifts could impact many species. The Paper Birch is one such example of a climate-sensitive species. Typical of colder climates, Paper Birch stands grow alongside cold-water streams flowing down the banks of the river valley, emptying into the river. These streams produce a microclimate which has allowed Paper Birch stands to survive. In recent years, a decline in the health of paper birch has been observed, and documented in the USGS Open File Report "*Paper Birch Decline in the Niobrara River Valley*." Further climatological changes may affect other species and habitats similarly over time. Measures were chosen specifically to monitor this issue, because even if it is beyond the influence of any one refuge, changes can still help provide perspective with respect to wilderness character.

Another unavoidable issue facing the wilderness is the changes to habitat due to invasive species and fire exclusion. This is an issue facing many prairieland ecosystems. Three things—habitat, invasive species, and fire—are interrelated. The prevalence of invasive species can grow in the absence of fire, leading to a decline in quality habitat. Grazing has been used to offset this issue somewhat, but invasive species are nonetheless present in certain areas. Unfortunately, this issue is unavoidable because fire in the Fort Niobrara wilderness must be tightly controlled—whether the fire is natural, or prescribed. Naturally occurring fires within the wilderness must be responded to because the wilderness is small, and wildfires pose a threat to surrounding property owners. Prescribed burns are rare, but have been used in the past.

In relation to Wilderness Character, invasive species, fire, the natural quality, and the untrammelled quality are inextricably linked. Prescribed burns would constitute a form of trammeling, but could also benefit the natural quality greatly because regular fire reduces invasive plants, and enhances habitat for native plants species. The measures contained in this report addressing this relationship should reflect the cost/benefit of such a trade-off.



---

Much consideration was given to actions and monitoring activities already underway at the refuge while developing the measures. Moreover, collaborative efforts were developed between FWS and the Park Service, specifically for the Stream Water Quality measure. This was done to minimize the amount of extra work on refuge employees while maximizing the amount of data that can be shared to meet multiple needs. In short, this is to maximize efficiency.

However, there are still additional actions that would help in future wilderness character assessments. This includes additional data regarding the herbaceous dominated plant species data. Existing data on invasive dominated acreage is sparse, and it would take several people to traverse the entire wilderness, documenting all invasive species to achieve the full extent of this measure. This is not considered feasible, and instead this measure will use information as it becomes available, while relying on the institutional knowledge of refuge staff to fill in the gaps. However, as more data is gathered, the effectiveness of this measure increases. Also, changes to water quality sample collections could improve results. For example, collecting on the same dates every year would eliminate the possibility for water temperature averages to be skewed due to data collection occurring during the early summer months one year, and the late summer months the next year.

Overall, these measures should establish baseline data regarding wilderness character against which improvements and declines in its quality can be measured in the future. This is an important step towards ongoing wilderness stewardship.

## Appendix A: Niobrara River Flow Volume

### Average Annual Flow

Niobrara River - Average Annual Flow			
Year	Average Flow Vol.	Year	Average Flow Vol.
1946	811	1980	707.1
1947	838.1	1981	641.4
1948	808.1	1982	754.7
1949	861.5	1983	807.9
1950	837.1	1984	844
1951	876.5	1985	691.2
1952	878.3	1986	823.7
1953	848.1	1987	792.7
1954	807.8	1988	772
1955	810.6	1989	661.2
1956	832.4	1990	681.9
1957	881.8	1991	717.2
1958	874.7	1992	699.7
1959	812.5	1993	779.1
1960	824.2	1994	745.3
1961	803.1	1995	818.9
1962	911.3	1996	783.5
1963	850.2	1997	821.4
1964	745.7	1998	845.9
1965	727.8	1999	856.9
1966	793	2000	808.3
1967	760.9	2001	803
1968	818	2002	710.5
1969	634.3	2003	730.5
1970	712.2	2004	676.3
1971	696.3	2005	727.5
1972	700.4	2006	659.9
1973	721.6	2007	720.9
1974	672.7	2008	767.6
1975	611.5	2009	781.9
1976	598.5	2010	855.7
1977	689.8	2011	895
1978	738.3	2012	
1979	672.2	2013	

Average Annual Flow Volume Summary	
Minimum	599
Maximum	911
Mean	778
standard deviation	76
2 standard deviations (low)	619
2 standard deviations (high)	922

## Average Peak Flow

Niobrara River - Peak Flow (highest monthly average)			
Year	Peak Flow (mo. avg)	Year	Peak Flow (mo. avg)
1946	1038	1980	991.7
1947	1230	1981	773.6
1948	996.8	1982	1052
1949	1464	1983	1279
1950	1001	1984	1403
1951	1013	1985	961
1952	1233	1986	1145
1953	1103	1987	1190
1954	1022	1988	1210
1955	1311	1989	956.9
1956	1101	1990	896
1957	1261	1991	966
1958	1214	1992	907.7
1959	1047	1993	1076
1960	1250	1994	1053
1961	991.5	1995	1385
1962	1298	1996	1075
1963	1107	1997	1096
1964	1069	1998	1092
1965	879.2	1999	1001
1966	1225	2000	1209
1967	1470	2001	1203
1968	1044	2002	930.2
1969	1016	2003	927
1970	935.6	2004	816.4
1971	1056	2005	1059
1972	966.6	2006	899.1
1973	872.9	2007	956.5
1974	938	2008	990.6
1975	818.2	2009	1070
1976	820.1	2010	1216
1977	937.4	2011	1251
1978	1115	2012	
1979	1013	2013	

Average Peak Flow Volume Summary	
Minimum	774
Maximum	1470
Mean	1074
standard deviation	158
2 standard deviations (low)	758
2 standard deviations (high)	1390

## Average Low Flow

Niobrara River - Low Flow (lowest monthly average)			
Year	Low Flow (mo. avg)	Year	Low Flow (mo. avg)
1946	615.5	1980	400.9
1947	630.2	1981	536
1948	700.4	1982	531.7
1949	641.9	1983	593.3
1950	735.2	1984	504
1951	678.9	1985	469.2
1952	624.1	1986	564.6
1953	656.4	1987	523.7
1954	675.3	1988	523.9
1955	644	1989	449.8
1956	692.2	1990	485.6
1957	759.1	1991	485.3
1958	707	1992	575.9
1959	675.1	1993	550.5
1960	672.5	1994	507.7
1961	639.2	1995	523.7
1962	733.5	1996	553.4
1963	694.1	1997	627.4
1964	485.7	1998	585.1
1965	570.5	1999	550.4
1966	581.6	2000	544.4
1967	506.2	2001	492.6
1968	447.9	2002	432.3
1969	430.2	2003	467.8
1970	419.2	2004	548.3
1971	427.1	2005	464.6
1972	482.2	2006	425.6
1973	433.7	2007	435.6
1974	383.3	2008	516.5
1975	432.9	2009	521.8
1976	431.7	2010	506.5
1977	469	2011	597.5
1978	430.6	2012	
1979	466.2	2013	

Average Low Flow Volume Summary	
Minimum	383
Maximum	759
Mean	546
standard deviation	97
2 standard deviations (low)	352
2 standard deviations (high)	740

## Appendix B: Measure Prioritization Worksheet

*In each row, write the indicator and potential measure in the left column. Use the following criteria and ranking guide to create an overall score for each measure. Those measures with the highest overall scores should be the highest priority for assessing trends in wilderness character.*

**A.** Level of importance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):

High = 3 points, Medium = 2 points, Low = 1 point

**B.** Level of vulnerability (measures an attribute of wilderness character that currently is at risk, or might likely be at risk over 10-15 years):

High = 3 points, Medium = 2 points, Low = 1 point

**C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):

High = 3 points, Medium = 2 points, Low = 1 point

**D.** Degree of reasonableness (the measure is related to an existing effort or could be monitored without significant additional effort):

High = 1 point, Low = 0 point

### Untrammelled

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
<b>Indicator:</b> Actions authorized by the Federal land manager that manipulates the biophysical environment. <b>Measure:</b> Acres of prescribed burns.	3	3	3	1	10
<b>Indicator:</b> Actions authorized by the Federal land manager that manipulates the biophysical environment. <b>Measure:</b> Number of other authorized actions that manipulate plants, animals, pathogens, soil, water, or fire.	2	3	2	1	8
<b>Indicator:</b> Actions not authorized by the Federal land manager that manipulates the biophysical environment <b>Measure:</b> Number of other	2	1	2	1	6



Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
unauthorized actions by agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water or fire.					

## Natural

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
<b>Indicator:</b> Plant and animal species and communities. <b>Measure:</b> Inventory of herbaceous dominated invasive plant communities.	3	3	3	1	10
<b>Indicator:</b> Plant and animal species and communities. <b>Measure:</b> Species of special management significance.	3	2	2	1	8
<b>Indicator:</b> Physical resources <b>Measure:</b> Niobrara flow volume	2	2	3	1	8
<b>Indicator:</b> Physical resources <b>Measure:</b> Extent and magnitude of change in Niobrara River water quality	2	1	3	1	7
<b>Indicator:</b> Physical resources <b>Measure:</b> Stream flow volume	2	2	2	1	7
<b>Indicator:</b> Physical resources <b>Measure:</b> Extent and magnitude of change in stream water quality.	2	1	2	1	6
<b>Indicator:</b> Physical resources <b>Measure:</b> Air quality – visibility based on average deciview.	1	1	2	1	5
<b>Indicator:</b> Biophysical processes <b>Measure:</b> Animal Unit Months (AUM's) of bison grazing/acre.	3	2	2	1	8

## Undeveloped

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
<b>Indicator:</b> Non-recreational structures, installations, and developments <b>Measure:</b> Miles of fencing	2	3	3	1	9
<b>Indicator:</b> Non-recreational structures, installations, and developments <b>Measure:</b> Miles of non-recreational road and trail	3	3	3	1	10
<b>Indicator:</b> Non-recreational structures, installations, and developments <b>Measure:</b> Number of other non-recreational structures and installations.	3	3	2	1	9
<b>Indicator:</b> Inholdings <b>Measure:</b> Acres of inholdings	1	1	3	1	6
<b>Indicator:</b> Use of motor vehicles, motorized equipment, or mechanical transport. <b>Measure:</b> Number of authorized motor vehicle or mechanical transport entries	2	3	2	1	8
<b>Indicator:</b> Use of motor vehicles, motorized equipment, or mechanical transport <b>Measure:</b> Number of non-authorized motor vehicle or mechanical transport entries	2	2	1	1	6

## Solitude or primitive and unconfined recreation

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
<b>Indicator:</b> Remoteness from sights and sounds of people inside the wilderness <b>Measure:</b> Number of river-based visitors	3	3	3	1	10

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
<b>Indicator:</b> Remoteness from sights and sounds of people inside the wilderness <b>Measure:</b> Number of visitors to Fort Falls	3	3	1	1	8
<b>Indicator:</b> Remoteness from sights and sounds of people inside the wilderness <b>Measure:</b> Number of visitors on horseback	2	2	1	1	6
<b>Indicator:</b> Remoteness from occupied and modified areas outside the wilderness <b>Measure:</b> Acres of wilderness affected by adjacent access routes, travel routes, or development.	2	2	3	1	8
<b>Indicator:</b> Facilities that decrease self-reliant recreation <b>Measure:</b> Miles of developed recreational trails	2	2	2	1	7
<b>Indicator:</b> Facilities that decrease self-reliant recreation <b>Measure:</b> Number of other recreational facilities/installations	2	3	2	1	8
<b>Indicator:</b> Management restrictions on visitor behavior <b>Measure:</b> Index of restrictions on river-based visitors	2	3	2	1	8

## Appendix C: WCM Time Commitment

Quality	Indicator	Measure	Were data gathered from office paper files, computer files, or field work (professional judgment is an option)?	Time you spent gathering data for each measure	Comments
Untrammeled	Authorized actions	Acres of prescribed burns	Troy Davis, Steve Hicks, FMIS database	1	FMIS database has detailed fire info, but Troy, Steve, or Alan are all aware of fire in the wilderness, and could be give info.
Untrammeled	Authorized actions	# of authorized actions that manipulate the biophysical environment	Alan Whited, professional judgement	1	Included bison moves, hunting, and invasive treatment.
Untrammeled	Unauthorized actions	# of other unauthorized actions that manipulate the biophysical environment	Alan Whited, professional judgement	1	No known unauthorized actions
Natural	Plant and animal species	Inventory of herbacious dominated invasive plant communities	GIS inventory	20	Includes contributing to the inventory in the field (Big and Little Beaver Creeks). This inventory however will continue to be a work in progress. Data is available in GIS database, and supplemented with professional judgment
Natural	Plant and animal species	Species of special management significance	Office paper files, professional judgement, endangered/threatened status, computer (group data) files	8	Decided that it's best to scan for available data, use any existing, and then ask refuge biologist for her professional judgment. However, bird census data may become available after 2012
Natural	Physical resources	Niobrara Flow volume	USGS National Water Information System - USGS water monitoring point 06461500	2	Some time is required to sort and analyze existing data to get the appropriate values.

Natural	Physical resources	Extent and magnitude of changes in Niobrara River water quality	NPS Niobrara River water quality data. NPS Contact: Pam Sprenkle, NPS Resource Management Specialist.	2	Future data should be able to be collected with a phone call or email to NPS in Valentine. <1 hr.
Natural	Physical resources	Stream flow volume	Kathy McPeak, FTN Biologist	2	Refuge biologist tracks this measure, and keeps data available
Natural	Physical resources	Extent and magnitude of changes in stream water quality	NPS Stream water quality data	4	Stream water quality data collection began on July 9th, 2012. Stream water quality data will be gathered several times during the summer months annually by NPS staff and shared with USFW for purposes of wilderness character monitoring.
Natural	Physical resources	Visibility based on average deciview	Nationally compiled data	1	Got data in an email from Jill Webster
Natural	Biophysical processes	AUM's of bison grazing	Alan Whited, professional judgement	1	
Undeveloped	Non-recreational structures, installations, and developments	Miles of fencing	GIS database measurement	1	
Undeveloped	Non-recreational structures, installations, and developments	Miles of non-recreational road and trail	GIS database measurement	1	there is a shapefile showing existing roads and trail
Undeveloped	Non-recreational structures, installations, and developments	Number of existing installations and infrastructure	Alan Whited, professional judgement	1	
Undeveloped	Inholdings	Acres of inholdings	Alan Whited, professional judgement	1	No inholdings
Undeveloped	Use of motorized or mechanical	Number of authorized motor vehicle, or mechanical transport entries	Alan Whited, professional judgement	1	



Undeveloped	Use of motorized or mechanical	Number of non-authorized motor vehicle or mechanical transport entries	Alan Whited, professional judgement	1	
Solitude +	Remoteness from inside	Number of river-based visitors	2011 Report of River Recreation on Fort Niobrara NWR	2	
Solitude +	Remoteness from inside	Number of visitors to Fort Falls	National Park Service by car counter. Contact NPS for updates to annual visitation.	4	Took extra time to get NPS to send data.
Solitude +	Remoteness from inside	Number of visitors on horseback	Alan Whited, professional judgement	1	
Solitude +	Remoteness from outside	Acres of Wilderness affected by access or travel routes	GIS database measurement	4	Created buffer around access/development in adjacent land before calculating acres affected.
Solitude +	Facilities that decrease self-reliant recreation	Miles of developed recreational trails	Paper docs, Alan Whited. Site visits	3	Site visit to Fort Falls trail to measure distance of trail
Solitude +	Facilities that decrease self-reliant recreation	# of other recreational facilities/installations	Paper docs, Alan Whited. Site visits	3	Site visit to Fort Falls trail to count number of installations
Solitude +	Mgmt restrictions on visitor behavior	Index of restrictions on river-based visitors	Paper files. Site visit. L.E. officer Brett Bowser.	4	
Cultural / historical resources	Loss of statutorily protected cultural resources	# of fossil or archeological artifact removals	Alan Whited, professional judgement	1	

## Appendix D: Stream Flow Volume Data

2011 Stream Flow (c.f.s.) Monitoring - Fort Niobrara NWR			
Date	Crooked	Big Beaver	Fort Falls
5-Apr	1.08	2.73	N/A
6-Apr			
27-Apr	1.07	2.36	N/A
29-Apr			
26-May	1.16	3.8	N/A
27-May			
8-Jun	1.12	2.45	N/A
9-Jun			
22-Jun			
23-Jun	1.09	6.4	N/A
24-Jun			
5-Jul			
6-Jul	0.97	1.92	N/A
18-Jul	0.8	1.33	N/A
19-Jul			
1-Aug	0.8	1.77	N/A
2-Aug			
15-Aug	0.89	2.16	N/A
Total	8.98	24.92	N/A
Average	1.00	2.77	N/A
<b>Total average</b>	<b>3.77 c.f.s.</b>		

---

## Appendix E: Fort Falls Visitation Data

---

Fort Falls Visitation	
Year	Vehicles
2002	2350
2003	15263
2004	7290
2005	8122
2006	8883
2007	8366
2008	8514
2009	7534
2010	8037
2011	
2012	
2013	